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JC20 Rec'd PCT/PTO 1 6 SEP 2005A FASTENING DEVICE

5 The present invention relates to a fastening device, particularly for fastening metal to metal connections, and more particularly to a device for fastening together two pieces of material in which mating holes are formed, such as two metallic automotive components.

10 For example, an automobile engine has a sump cover that requires fixing securely to the engine block in order to contain oil inside the sump without any leakage. Usually this is achieved by drilling and tapping a large number of bores around the perimeter of an opening in the engine block and drilling corresponding holes through the sump cover. Bolts are inserted through the holes in the cover and through corresponding holes in a gasket and then screwed into each bore. The screwing in of each bolt is hand started and then
15 finished by machine.

Although a secure connection is obtained, there are several problems associated with this practice. A typical sump cover can be fixed to an engine block using 30 or more bolts. It is both time consuming and expensive to drill and tap a hole for each bolt and then to screw each bolt in and have it machine
20 tightened. When the sump requires servicing it is equally difficult to remove the threaded bolts, which over time can become stuck in place.

It is an object of the present invention to alleviate these problems in a simple and effective manner.

25 According to the invention, a fastening device for retention in a hole comprises an elongate shank with a head and a threaded portion in screw threaded engagement with a cylindrical retainer member, in at least part of whose outer surface there is an annular recess, the depth of which increases in the direction towards the head, the recess accommodating an expandable

member whose internal surface engages the surface of the recess and which extends out of the recess.

5 The fastening device can be used in place of conventional bolts for fastening together metallic automotive components. The shank is threadable into the cylindrical retainer member, the outer surface of which is not tapped but includes a tapered recess. The expansible member is fitted in the recess and the device is then inserted with a certain amount of force through a hole in one component into a bore in the other component. When the force is removed, the shank will move a certain distance in the direction out of the bore, e.g. as one
10 or other component or a gasket interposed between them expands slightly, and this movement of the shank will cause the tapering surface of the base of the recess in its outer surface to engage the expansible member and cause it to expand into locking contact with the wall of the bore, thereby locking the two components together.

15 An advantage of the fastening device is that the retainer member slides into the bore. Thus each bore can be plainly drilled and does not require tapping. This is both a cost saving and a labour saving over conventional threaded bolts. The fastening device is easily installed and locked in position, since no rotation is necessary.

20 Optional features of the invention are set out in the dependent claims. A spring preferably engages the shank in the vicinity of the head and is adapted to engage the margin of the hole and urge the shank in the direction out of the hole. The shank requires loading in order to lock the fastening device into place, and the spring can therefore be used to ensure that the load urging the
25 shank in the direction out of the bore is sufficient if the resilience provided by the cover and gasket, where present, is not sufficient.

The expansible member of the fastening device is preferably a metallic ring, preferably in the form of a split ring. Metal, such as spring steel, is resilient enough when formed as a split ring for the ring to be resiliently

expansible, yet it also is very tough. Thus, the ring is able to dig into the sides of the bore for locking the fastening device into place and remaining locked over long periods of time.

5 The surface of the recess is preferably frustoconical and the internal surface of the ring may also be frustoconical and complementary to the recess surface. This is preferred as the ring can tighten against the tapered surface of the cylindrical retainer recess whilst being maintained in a symmetrical position with respect to the axis of the shank as the shank is unloaded after insertion into the bore. The angles of inclination of the ring internal surface and of the recess tapered surface preferably complement each other so that a close fit can be ensured between the two components. The external surface of the ring preferably has a sharp outer edge at the end of the ring directed toward the shank head. Thus as the ring expands around the widening taper upon unloading of the shank, the outermost edge of the ring external surface digs into the bore surface for locking engagement therewith.

15 The shank may comprise longitudinally spaced ribs for engagement with the margin of a hole in the spring. The ribs enable the spring to engage the shank for urging the shank out of the bore.

20 The fastening device is preferably used for fastening together two metallic automobile components such as a sump and a sump cover. Significant savings can be made in using the fastening device for such an application that requires many such fastenings.

25 The present invention will now be explained in more detail by the following non-limiting description of a preferred embodiment and with reference to the accompanying drawing in which:-

Fig.1 is a schematic cross-section of a fastening device according to the invention when in situ fastening a sump cover to an engine block.

Fig.1 shows a fastening device 1 comprising a shank 2 inside a bore 3 in an engine block 5. The shank 2 comprises an elongate member having a head

portion 10 at one end thereof, a ribbed portion 12 adjacent to the head portion, a necked portion 14 and a threaded portion 16 extending away from the head portion 10. The head portion 10 includes a handgrip 18 for use in installing the shank 2 in the bore 3.

5 The fastening device 1 also comprises a cylindrical retainer member 20 that is of a length that may be slightly shorter than the threaded portion 16 of the shank 2. The cylindrical retainer member 20 has a diameter that is substantially the same as that of the bore 3 into which it is to be installed such that the cylindrical retainer member 20 fits closely inside the bore.

10 The cylindrical retainer member 20 is of a generally annular cross-section. At least part of the inner surface of the retainer member 20 is in threaded engagement with the threaded portion 16 of shank 2. The outer surface of retainer member 20 includes a tapered recess 24 that extends over at least part of its length. The tapered recess has a depth that increases towards
15 the end of the retainer member 20 that is closest to the head 10 of shank 2.

 The fastening device further comprises an expansible split ring 30. The expansible ring 30 preferably has a regular trapezoidal cross-section such that its side surfaces are inclined away from each other at the upper surface of the ring 30 as shown in Fig.1. The ring 30 has a gap (not shown) at one point in its
20 circumference so that the size of the ring 30 may be expanded by moving its two free ends apart. The expansible ring 30 is thus preferably manufactured from spring steel such that the ring 30 has the desired properties of toughness and flexibility whilst being hard-wearing. However, any other such suitable material could be used. The upper outer edge of the ring is defined by two
25 surfaces which extend at less than 90°, preferably about 70°, to each other and is thus relatively "sharp" and thus capable of deforming, that is to say digging into, the surface of the bore.

 The fastening device also includes a spring 40. In this embodiment of the invention, the spring is of a plate spring type and has a central aperture in

which the ribbed portion of the shank 12 is received. The spring 40 has a thin elongate cross-section that is bent upwards at the inner 42 and outer edges of the cross-section as shown in Fig.1. The centre portion 44 of the ring cross-section remains flat. The thickness of the spring 40 is just sufficient to enable the inner edge 42 to engage between two ribs of the ribbed portion 12 of shank 2.

The fastening device 1 is shown fastening a metal sump cover 7 to an engine block 5, with the interposition of a sealing gasket 9. The bore 3 in the vessel 5 is a plain bore and requires no tapping. The cover 5 and gasket 9 contain holes that correspond to each of the bores 3.

The fastening device 1 is used by first threading the cylindrical retainer member 20 over the threaded shank portion 16 of the shank 2. The ring 30 is fitted around the retainer member 20, so that it sits in the tapered recess 24. The inclined inner surface of the ring 30 engages to the surface of tapered recess 24 towards the upper end of the recess. Cover 7 and gasket 9 are placed over the bore 3 so that the holes in the components are aligned. Spring 40 is fitted over the ribbed portion of shank 2 so that its inner portion 42 engages between two ribs thereof. The shank 2, with retainer member 20 and ring 30 are then forcibly inserted through the holes in the cover 7 and gasket 9 and into the bore 3. The force of insertion of the fastening device 1 loads the device in direction 'A' as shown in Fig. 1. When the fastening device is fully inserted into bore 3, the flat portion 44 of spring 40 rests on top of the cover 7 and the spring is deformed and urges the shank in the direction out of the hole. A rib 13 of the ribbed portion 12 of shank 2 bears against the spring 40. The handgrip 18 is then released.

The spring 40 provides a resilient force against the compressive force in direction 'A' on the shank 2 such that when the user releases the load on hand grip 18, the fastening device 1 is moved a small distance out of the bore 3 in direction 'B', as shown in Fig.1. This causes cylindrical retainer member 20 to

move vertically upwards, its tapered recess 24 mating against the inner surface of ring 30 and forcing the ring 30 to expand. Consequently, as the gap between cylindrical retainer member 20 and the bore 3 decreases, the outer surface of ring 30 digs into the surface of the bore 3, thereby preventing further outward movement of the shank and locking the fastening device 1 in place.

In certain applications of the fastening device 1, the cover 7 and gasket 9 provide enough resilience against the load applied to shank 2 in direction 'A' to bias the fastening device 1 out of the bore 3 sufficiently without the need for spring 40 to be used. In this case, a metallic plate having a suitable aperture (not shown) replaces the spring 40 to provide a surface against which the ribs 13 of the ribbed portion 12 can locate. Alternatively, the head 10 is enlarged so that it will engage the margin of the hole, in which event the fastening device will resemble a conventional bolt. In use, the bolt is simply inserted into the hole and rotated, e.g. by one turn, and this is sufficient to lock it in position.

The fastening device 1 is removable in a conventional manner by unscrewing the shank 2 out of the retainer 20. In this event, the retainer and ring may be loose in the hole and may be removed separately for re-use or they may remain fixed in position by virtue of the fact that the ring has deformed the wall of the bore, in which case it may simply be re-used when the shank is re-inserted.

Various modifications may be made to the embodiment described without departing from the scope of the invention as defined by the following claims.